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Simulation Database Archive and Reuse Project

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ABSTRACT: *One of the continuing challenges to the Modeling and Simulation (M&S) community is finding the appropriate terrain databases (TDBs) for a simulation exercise. The U.S. Army Topographic Engineering Center (TEC) has produced a number of terrain databases through contract, in-house, and cooperative efforts. Over the years these efforts have accumulated a list of TDBs that are available to the DoD M&S community. Unfortunately, many of these databases were not created with reuse in mind. This paper will summarize the efforts of the Simulation Data Archive and Reuse (SDAR) project sponsored by the Defense Modeling and Simulation Office (DMSO), managed by the Terrain Modeling Projects Office (TMPO) of the National Imagery and Mapping Agency (NIMA), and executed by TEC. The project covers the entire process from cataloging existing databases to making them available via the Master Environmental Library (MEL) in several, commonly used compilations. This paper details that process and lists the databases currently available for reuse.*

1. Introduction

The Defense Modeling and Simulation Office (DMSO) sponsored the Simulation Database Archive and Reuse (SDAR) project in an effort to render previously exercise- or demonstration-specific databases usable to a larger community. The Terrain Modeling Projects Office (TMPO) of the National Imagery and Mapping Agency (NIMA) was tasked with management of the program, with the U.S. Army Topographic Engineering Center (TEC) serving as the executing organization.

The effort began in March 1997 and will continue through September 1998. There were seven tasks associated with the project. They include: cataloging the existing S1000 databases available for U.S. Government work, surveying the user community to determine requirements for the databases, creating FGDC-compliant metadata for a sampling of the databases, archiving and updating the top ten databases, creating a model library of S1000 models available for reuse, publishing the metadata and advertising the databases on the Master Environmental Library (MEL), and writing a management plan for configuration management of the databases.

2. Cataloging Existing Databases

The Simulation Database Archive and Reuse (SDAR) addresses databases that have been generated by the S1000 simulation terrain database tools [1]. The three primary S1000 database developers are: TEC, Lockheed Martin Corporation (Bellevue), and LNK Corporation. A fourth contractor, ZelTech, has been a key performer in updating and distributing these databases. Each of the databases held by the contractors and TEC was researched and cataloged. Many of the databases are not available for reuse or detailed cataloging for a number of reasons. In many cases, particularly at the inception of the Odin [2] and SIMNET programs, there was no requirement for reuse or for extensive documentation, therefore, there is little information available about those databases. Often the information contained in the database is not worth the time or money to extract it from an out-of-date format to support reuse. Other databases were created for customers other than the U.S. Government, for demonstrations or proposals, or as special subsets of existing databases (Lockheed-Martin). The remainder of the databases were cataloged according to the level of demand for them and their currency.

Each of the databases in TEC's archives were cataloged and read for content. Documentation was created for each of the tapes, including information on the

distribution date, type of files, compiler used, and whether or not there was an error in reading the files. From this information a list was compiled to make sure that source data were available for each of the databases, and the list was placed on a server at TEC.

3. Survey of the User Community

The user community was surveyed to determine which databases were requested most often. For this effort, the user community was defined as the following organizations: U.S. Army Simulation Training and Instrumentation Command (STRICOM); 7th Army Training Command in Grafenwoehr, Germany; U.S. Army simulation training facilities, Fort Rucker, AL; U.S. Army simulation training facilities, Fort Knox, KY; Institute for Defense Analyses (IDA); U.S. Army National Simulation Center; U.S. Army Training and Doctrine Command components (various locations); and all customer requests through TEC (industry, academia, other government organizations).

The result of the surveys produced a list of S1000 simulation terrain databases that were updated as a part of the project. By updating, databases became self-contained and usable through the S1000 Application Programmer Interface (API). Each database in the list of the top requested databases was evaluated for reusability, and the list was subsequently revised. Actual methodology for updating those databases is discussed next in Section 4.

4. Create FGDC-compliant Metadata

The project required creating metadata about each of the databases. This metadata is Federal Geographic Data Committee (FGDC) compliant. Because the ultimate goal is reuse, it also was put into a specific FGDC-compliant format that MEL could read. (MEL is a part of the Modeling and Simulation Resource Repository (MSRR), which is designed to catalog available resources and make them available through the internet.)

The minimum FGDC-required metadata is not specifically targeted at simulation data. The metadata created for this project was written in MEL format, with additional fields added for maximum reuse potential. Those fields will be included in all future database design documents, and are listed as follows: Geographic Datum, Projection/spheroid, Coordinates in latitude and longitude, Coordinates in UTM, Database size (extent), Location of high resolution inserts, Graphic of coverage superimposed on DMA/NIMA map, Resolution of database, Compatible formats (different from software version), Points of Contact, FGDC-compliant metadata, SEDRIS-compliant metadata, Data specific for MEL format, Software versions available, Date of creation for each version, Name of texture library, Name of model library, Header file names for locating information within the database, and Instructions necessary to use the database or extract information.

5. Archive and Update the Databases

One objective of this project was to render formerly limited databases reusable to a larger community. This was accomplished by ZelTech Corporation and the Lockheed-Martin Corporation for the top ten databases. Lockheed-Martin personnel wrote utilities and documentation for those utilities to test a database for S1000 API compatibility. ZelTech performed those tests on a number of databases, wrote a script to incorporate the Lockheed-Martin utilities, and made sure that the SEDRIS API could read each database. These steps were accomplished iteratively as errors in the databases were corrected to make them compatible with the APIs.

All of the databases have some degree of error in them, which was acceptable for the original purpose of the database. Although not all the errors contained in the databases (cracks or anomalies) were corrected, they are all noted in header files that result from the various checks performed on the databases. Although every error in each database was not fixed, they were made robust enough for reuse and distribution. The S1000 source data of the databases was re-compiled into the following formats: S1000 v. 3.7; ModSAF c5b and c7b; MultiGen flight v. 12 or 14; and OpenScene (S1000 version). The ten databases were then pressed onto CD-ROMs and are now available through MEL and at the Simulation Interoperability Workshop (SIW) to government personnel and contractors working on a government contract. A description of some of the databases follows:

Military Operations in Built Up Areas (MOBA), Fort Benning, GA. A 24 by 24 km high resolution database of the McKenna Military Operations in Urban Terrain (MOUT) site was created. The structures were modeled according to blueprints, and all cultural features were placed according to their geo-specific coordinates. Some of the pertinent buildings were modeled inside and out for movement of dismounted infantry troops. The project was initiated for the U.S. Army Training and Doctrine Command's (TRADOC) Dismounted Battlespace Battle Laboratory.

Camp Pendleton, CA. The Camp Pendleton database is one of several databases created under the Synthetic Theater of War (STOW) program for the Defense Advanced Research Projects Agency (DARPA). It is 40 by 40 km and includes bathymetry and destructible entities (multi-state objects).

National Training Center (NTC TIN). This database was created as an enhancement for the original, gridded NTC database. It covers a 50 by 50 km area in the region of the California Mojave desert. Use of new mobility codes led to some anomalies in SAF behavior in mountainous "no-go" areas.

Hunter-Liggett, CA. One of the most widely distributed and used SIMNET databases, Hunter Liggett represents a 50 by 50 km area in California. It has large variations in terrain relief, with forested areas as a significant feature. It was the database originally used in the first DIS exercise at the Industry/Interservice Training Systems and Education Conference (I/ITSEC) in 1992.

Camp Lejeune, NC. This database is 140 by 140 km representing the Onslow County, North Carolina area. It encompasses the Marine Corps Base of Camp Lejeune. The database was completed in 1997 for an exercise within the Joint Countermine Operational Simulation (JCOS), and incorporates bathymetry for inland waterways, as well as the ocean.

6. Create a Model Library

A model library was completed by Mr. Vineet Gupta, TEC, with a final report [3] generated specifically detailing this task. It became immediately apparent that to reuse S1000 models, it was necessary to work through the S1000 API using the Synthetic Environment Data Representation and Interchange Specification (SEDRIS). Work had previously been completed to translate S1000 models into a SEDRIS-compatible viewer. However, because of numerous constraints of the S1000 API, a decision was made to use the SEDRIS API only for capturing graphics for model display within the library.

In the initial SDAR proposal, this task was written to incorporate all the S1000 model files into one directory. Upon interviewing database modelers at Lockheed-Martin (Bellevue), it was discovered that this approach had been tried and rejected. The results of that effort are called the "baseline" directory, which is still available. However, as S1000 developed through time, the size of a model directory containing all models was prohibitive for storing, loading, and distributing databases. The idea of one central location from which to pull the models, however, is still valid and is detailed in the final report. The model library is located on the TEC home page under the Data Holdings, Model Library. Available: http://www.tec.army.mil/TD/tvd/models/index.html.

The models have grown throughout time because of the number of instances necessary to render them in different simulation scenarios. For instance, in a SIMNET-level simulation there are three model files necessary - one for each viewing range. However, as the programs have developed (for instance in the STOW demonstrations), each model may require iterations, for example, several stages of destruction. For each level of destruction, three levels of detail for viewing ranges associated with each are required. There is one model file (.m2) for each stage and at each level of detail. A decision was made early on to limit the models incorporated into the model library to 1000, and not to include STOW models. The 1000 number is translated as 1000 .m2 files, of which three or more can be attributed to a single entity (ex. a house). The model library contains model libraries from several different S1000 terrain database projects.

7. Create Metadata and Publish on the MEL

The metadata and associated publication on the MEL is essential to reuse since it makes information about the databases available at all times without necessitating contact with one individual, who may or may not have the most current information. Through web access, database information can be accessed at any time and initial information that was previously disseminated through personal contact can be retrieved in a much more efficient manner.

Wider availability to numerous and varied customers also is a possibility with an on-line catalog. This cataloging with HTML and MEL is only the beginning. As databases are created, their associated metadata will be incorporated into the MEL and the specific information captured through a design document. The design document can then be placed on-line in addition to the metadata for specific, technical information.

8. Create a Management Plan for Configuration Management

The Management Plan is one of two documents that describes the process of creating, updating, archiving, and distributing past and future databases. The management

plan specifically addresses the SDAR project as it was executed, and will serve as a proposal to TEC management about future simulation database distribution.

In addition, a document specifically dealing with simulation terrain database distribution was created to serve as an addition to TEC's Standard Operating Procedure (SOP) 25-30-3. The SOP is titled "Information Management Standard Operating Procedure (SOP) Request, Release, Handling, and Distribution of TEC-produced Geospatial and Imagery Data." [4] The addition specifically lists requirements for handling simulation databases.

9. Conclusion

DMSO sponsored the SDAR project to fill in the gap that was created when databases were made without considering reuse as a priority. With the current environment of reuse, and the requirements for HLA and SEDRIS compliance for interoperable play, it has become imperative to put a process in place by which data are used more than once.

NIMA's TMPO team guided the execution of SDAR with an eye to customer requirements, funding constraints, and source data distribution. SDAR provided a roadmap delineating the way in which to update databases, and make them widely available to customers other than the original funding organization. Databases that were created for one purpose can now easily serve many purposes and organizations.

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9. References

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Author Biography

MICHELLE BEVAN serves as the technical point-of-contact for the SDAR project at TEC. She has worked with the modeling and simulation community for several years representing TEC regarding simulation terrain database issues. She recently completed her masters degree in Geographic and Cartographic Sciences at George Mason University, Fairfax, VA.